LambdaTable: Tiled Display Table for Working with Large Visualizations

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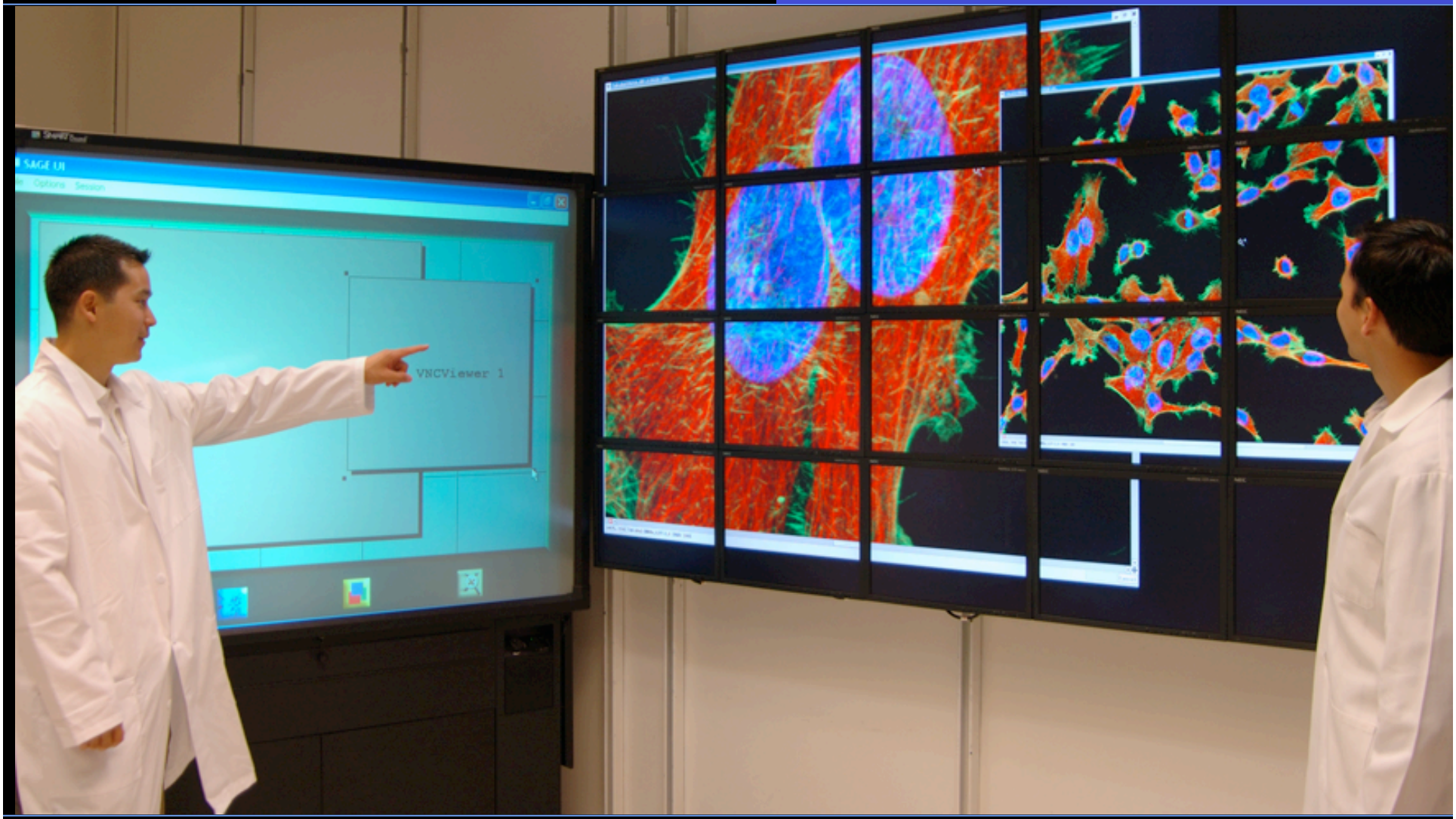
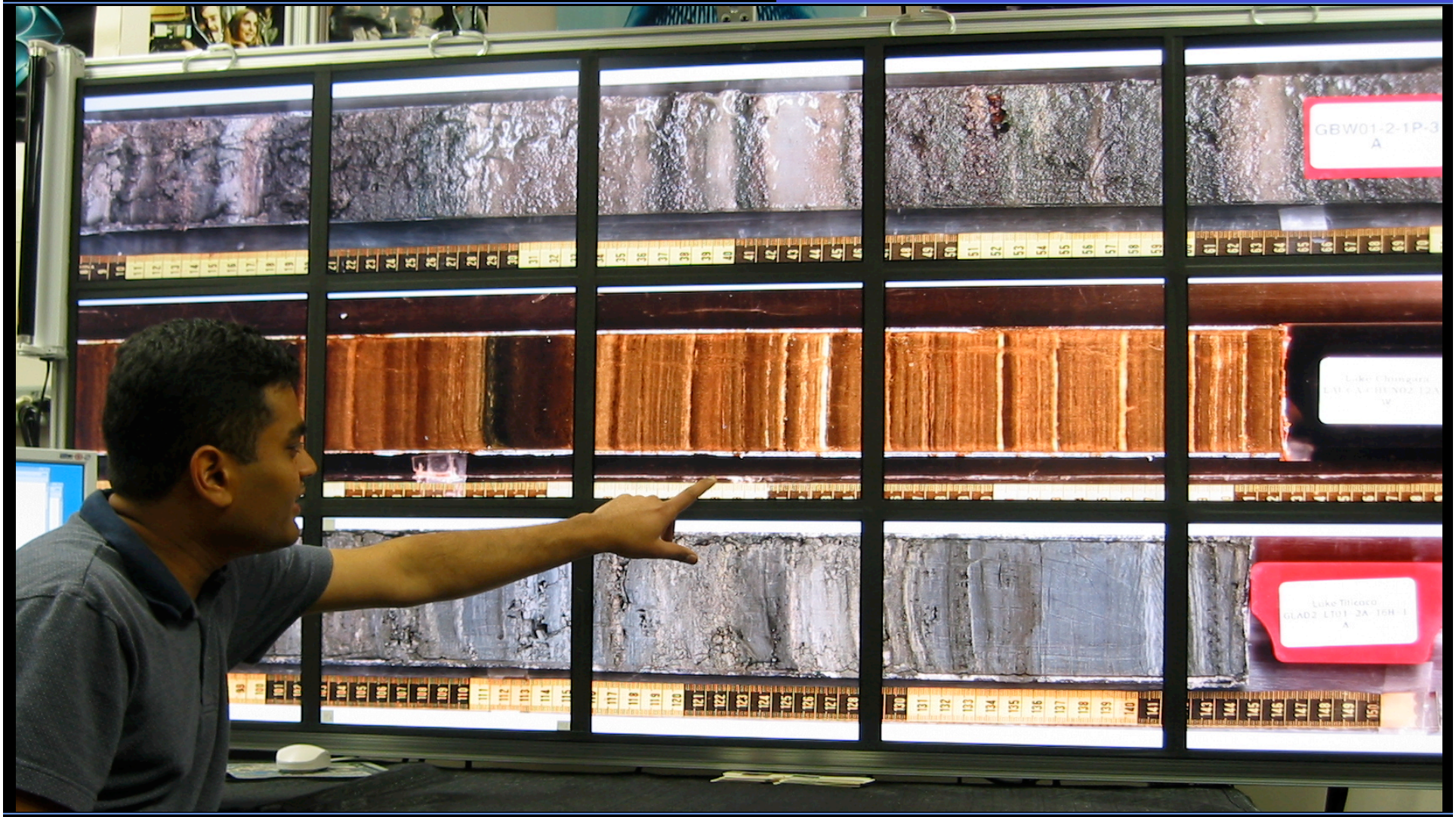
Rat Cerebellum Microscopy (NCMIR)



Core Sample Imagery (JOI)



The Challenge

Facilitate group work with very large datasets.

Not just visualization, but *interacting* with data.

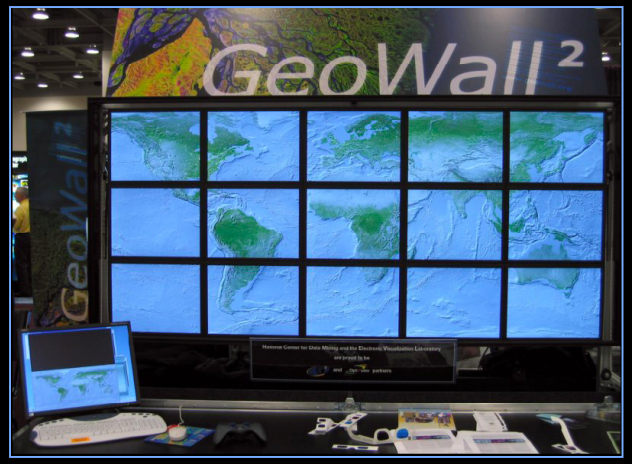
Our Approach

Apply:

Tangible User Interfaces
Table interaction findings
Co-present collaboration

TO:

Tiled display research
Optical network research



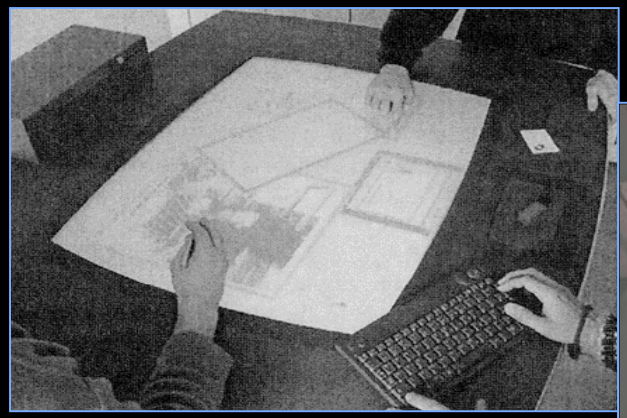
Our Solution

Build an interactive tiled-LCD visualization table.

- Support Visualization
  - Large, high-res display
  - Rendering cluster to “power”
  - Optical network to “fuel”
- Support Interaction
  - Common surface
  - Multiple user interfaces
  - Tangible user interfaces

LambdaTable at EVL

Other Tables



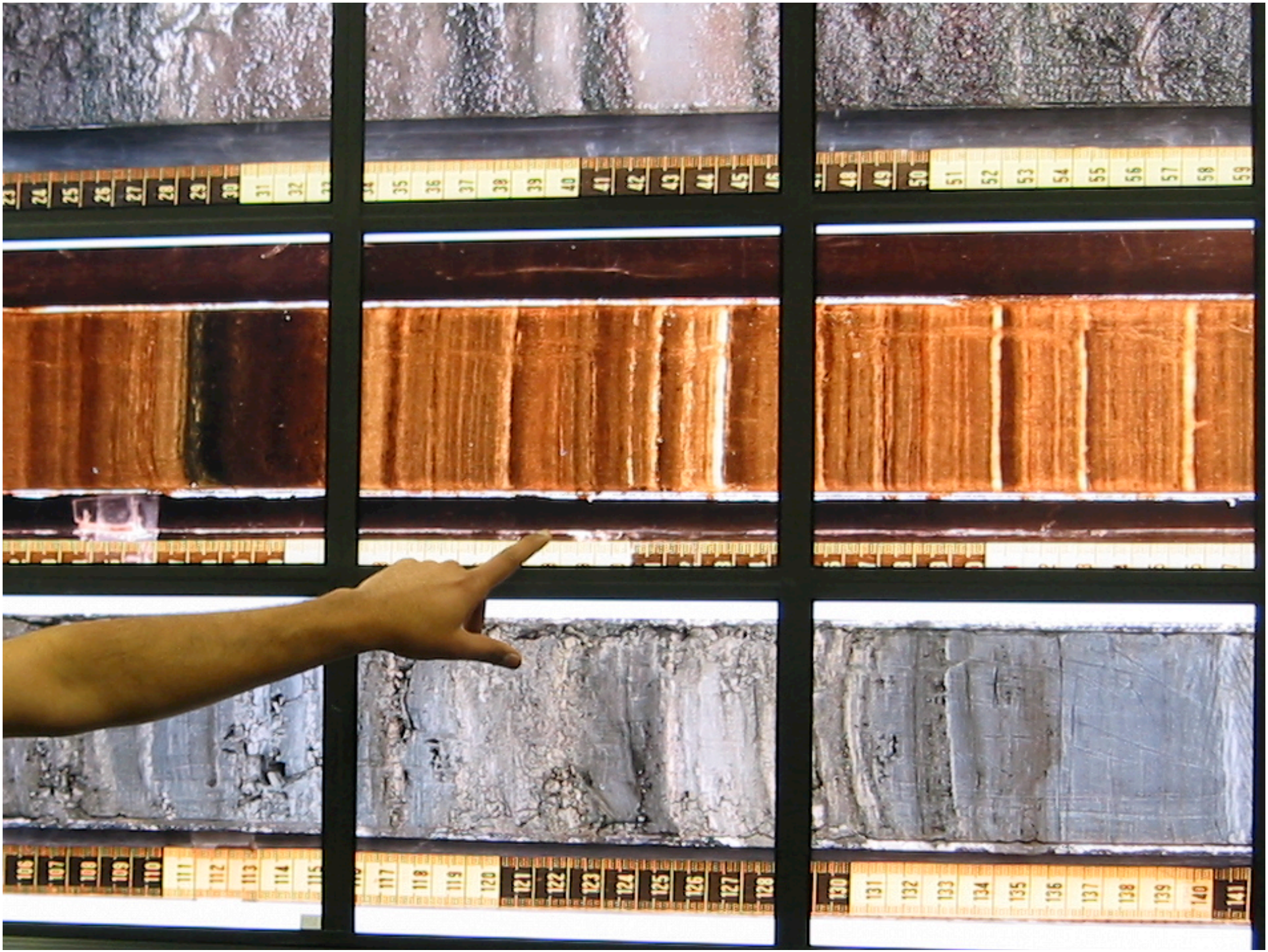
InteracTable
German Nat'l Research Center

iRoom Table
Stanford University

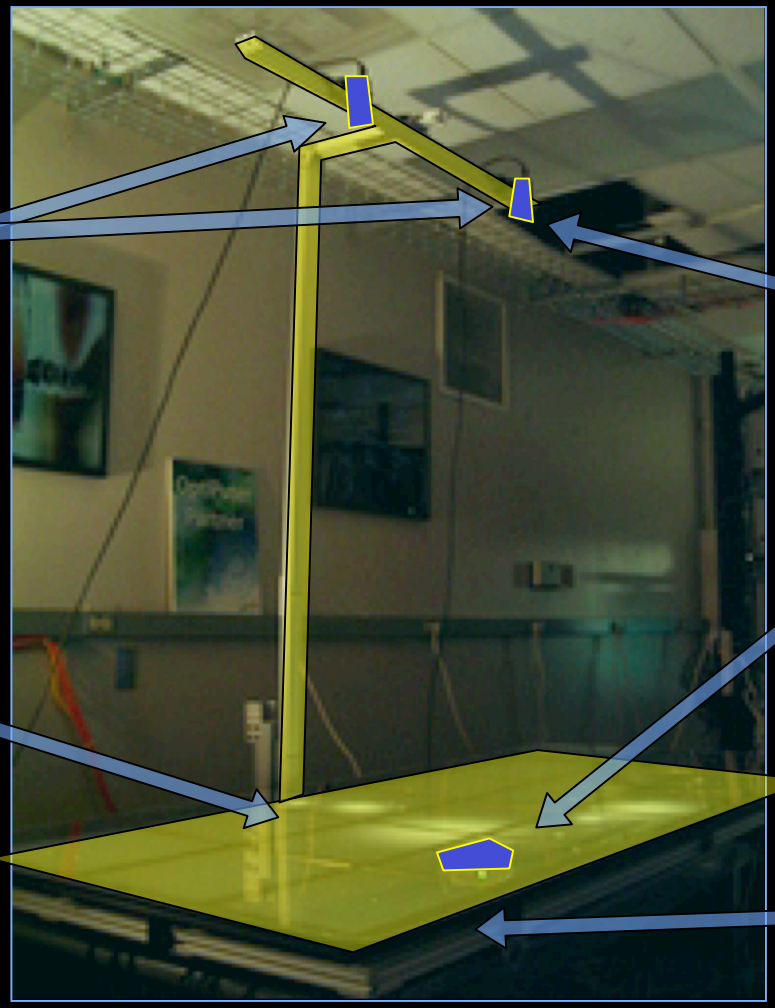
MetaDesk
MIT Media Lab

And many others…

All use single projector Max < 1200x1600 Not good enough!



LambdaTable Implementation



2 Cameras

IR Pass Filters

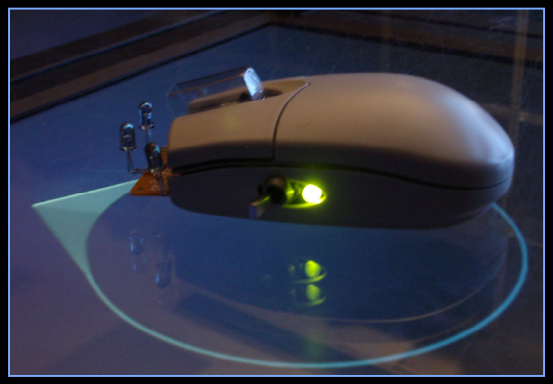
Tangible User Interface

15 LCD Tiles:
8000 X 3600

Fits up to 15 users around table

Tangible User Interface Tracking

- Tracked devices embedded with IR markers
- 2D pattern matching problem
- Any number of distinct patterns
- Position & Rotation



- Initial prototype “mouse” device
- Tracked at 30fps (rate of camera)
- Additional LEDs used to encode button clicks

Tracking System Demo

Applications

- Fitts' Validation
- Galaxy application
  - Application to test tracked mouse interaction
  - First person fly through of Hipparcos and Tycho sets
- Map application
  - Graphical map plotted
  - Panning/rotation tested
  - Next: satellite overlays

LambdaTable + LambdaVision + SAGE

Ubiquitous displays + Common display manager = Integrated project room

Future Applications

Two Example Scenarios:

Terabyte Imagery Workbench

Multi-Sensor Situation Table

Terabyte Imagery Workbench

- Display multiple large images
  - Multiple core scans, microscope images, video and volumes at once
  - Lay maps, sat imagery out flat. Familiar for geoscientists.
- Arrange, link, and annotate images
  - Look for correlations between geographically separate cores
  - Mark fiduciary points with tangible markers
  - Highlight / extract regions of interest directly on the images
  - Embed metadata / comments
- Create persistent workspaces (High Res!)
  - Use screen real-estate for organization and grouping
  - Orient data correctly for multiple users around table
    - Track position, rotation of a workspace phicon
  - Can be used for extended time periods

Multi-sensor Situation Table

- Emergency response, military and airport control centers.
  - Map centric. Real time video, satelite and sensor data.
- Maintain situational awareness amongst group members.
  - Provide “big picture” without sacrificing important detail
  - Use tangible markers to
    - Identify highway, infrastructure conditions
    - Designate ROIs for wall displays
    - Provide points of reference to facilitate “common ground”
- Rapidly query multi-sensor / multi-spectral data
  - Layer data from different source
  - Use physical lenses to overlay satellite / infrared / weather imagery
- Low maintenance, always on, always ready

What's the Next Step?

- This Fall:
  - Build new TUIs (small markers, magic lens, instruments)
  - Image manipulation app to test above devices
  - Investigate IR reflectors to reduce pattern footprint / bulk
- This Spring:
  - Evaluate / compare devices using human subjects
  - SAGE integration, investigate project room paradigms
- Next Summer and Beyond:
  - Tile cameras to improve UI resolution
  - Multi-input UI toolkit / Oriented multi-workspace toolkit

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Thank You

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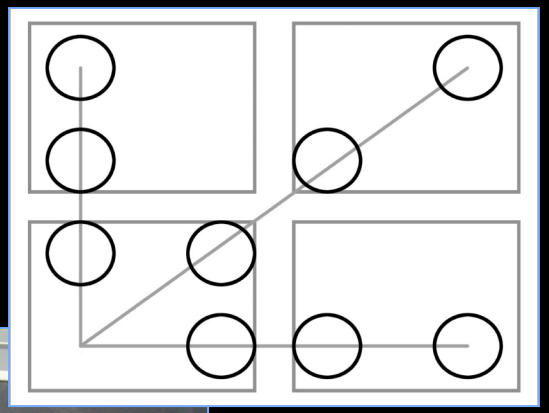
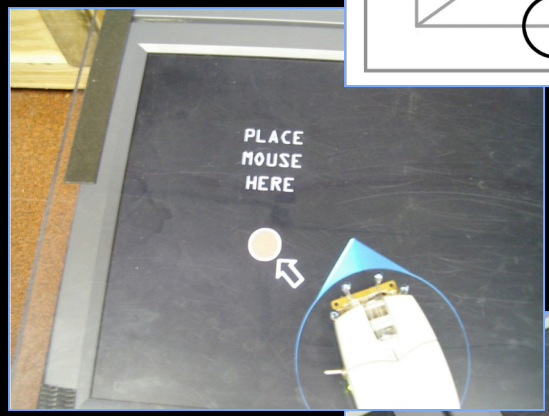
(coming soon)

Questions ???

Fitts' Law Validation

- Fitts' Law
  - Target acquisition gets easier as target gets closer, larger
  - Used to test if device "natural"
  - Traditional mouse is a Fitts' Device
- Fitts' Application
  - Built 4 tile system
  - Target acquisition
  - 3 sizes, 9 positions
  - No target occlusion
- Results to come…
  - Initial interaction promising





What about tiled projectors?

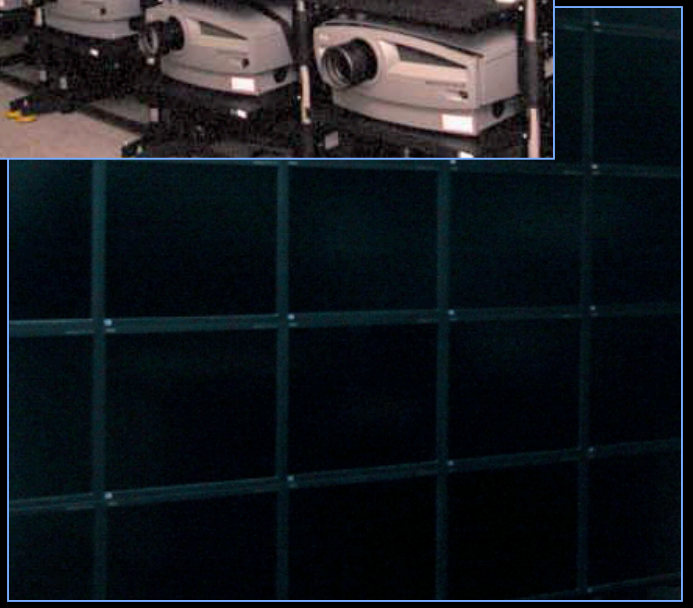
- Maintenance Intensive
  - Colormatching
  - Bulb changes
- Costly
  - 1024x768, 3000 lumen = $1600 vs 1600x1200 LCD = $1000
  - Bulb replacement = $350
  - Higher resolution = $$$!

LCD display table:

15 LCD panels - $15,000

Equiv projector table:

136 projectors - $217,600



Tiled LCDs

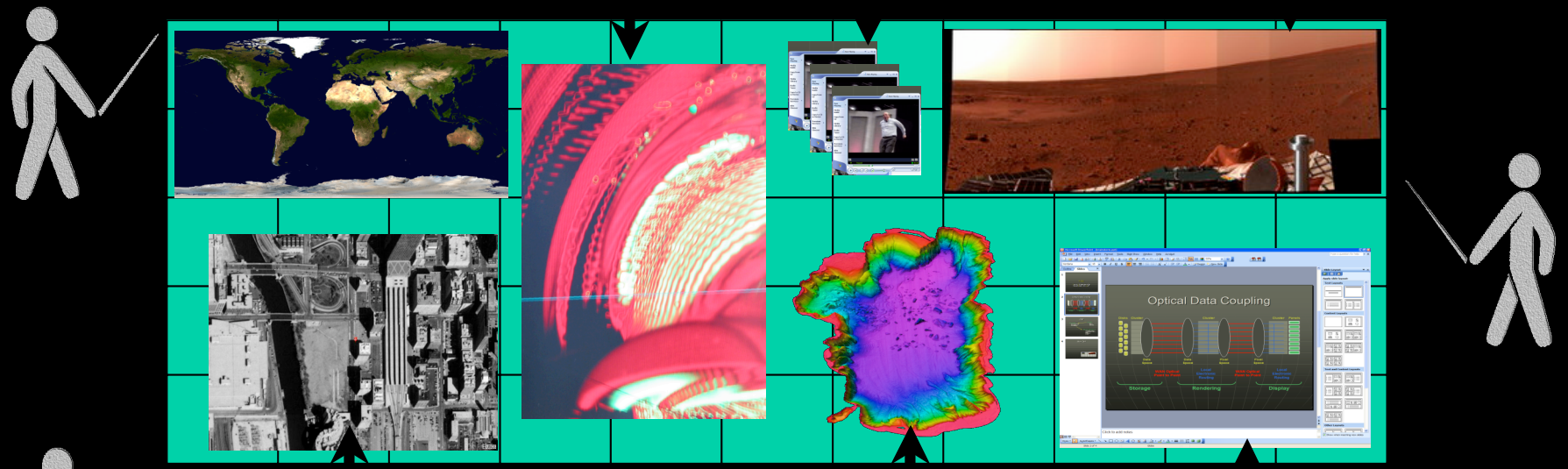
- Low Cost
- Bright
- Well colormatched
- Long “bulb life”
  - 3.5 years continuous
- Borders
  - Looking through windows
  - Explicitly hide pixels behind them to preserve continuity
  - Arrange text to avoid occlusion
  - OLED/Optics advancements may eliminate them altogether

Scalable Adaptive Graphics Environment (SAGE)

Live video feeds

Remote sensing

Volume Rendering



High-resolution maps

3D surface rendering

Remote laptop

1 ft per pixel aerial photography (USGS):